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World Intellectual Property Organization (WIPO) - Geneva, Switzerland
Organisation Mondiale de la Propriété Intellectuelle (OMPI) - Genève, Suisse

US 06/03394

P2 1446137

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office

May 01, 2006

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY OF THE BELOW IDENTIFIED INTERNATIONAL APPLICATION AS ORIGINALLY FILED AND ANY CORRECTIONS THERETO FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE ACTING AS A RECEIVING OFFICE UNDER THE PATENT COOPERATION TREATY.

APPLICATION NUMBER: *PCT/US06/00742*
FILING DATE: *January 05, 2006*

REC'D 09 MAY 2006

By Authority of the
Under Secretary of Commerce for Intellectual Property
and Director of the United States Patent and Trademark Office

H. L. Jackson

H. L. JACKSON
Certifying Officer

OME COPY

PCT/US06/PCT42

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

PCT/US 06/00742
International Application No.

05 JAN 2006 (05.01.06)
International Filing Date

PCT INTERNATIONAL APPLICATION
RO/US
Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference (if desired) (12 characters maximum) 4410 PCT CIP

Box No. I TITLE OF INVENTION A METHOD OF SEPARATING NON-METALLIC MATERIAL USING MICROWAVE RADIATION

Box No. II APPLICANT ☐ This person is also inventor

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

Gyrotron Technology, Inc.
2014 Ford Road
Unit K
Bristol, PA 19006 US

Telephone No.: (215) 826-8415
Facsimile No.:
Teleprinter No.:
Applicant's registration No. with the Office:

State *(that is, country)* of nationality: US

State *(that is, country)* of residence: US

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

Sklyarevich, Vladislav
2701 Dudley Court
Bensalem, PA 19020 US

This person is:
☐ applicant only
☒ applicant and inventor
☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office:

State *(that is, country)* of nationality: US

State *(that is, country)* of residence: US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

Carothers, Floyd B.
CAROTHERS AND CAROTHERS
445 Fort Pitt Blvd., Suite 500
Pittsburgh, PA 15219
US

Telephone No.: (412) 471-3575
Facsimile No.: (412) 281-2180
Teleprinter No.:
Agent's registration No. with the Office: 24,252

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

See Notes to the request form

PCT/US06/00742

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

SHEVELEV, Mykhaylo
301 Heights Lane
Feasterville, PA 19052 US

This person is:
- [ ] applicant only
- [x] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: UA
State *(that is, country)* of residence: US

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [x] the United States of America only [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality:
State *(that is, country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality:
State *(that is, country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality:
State *(that is, country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

[ ] Further applicants and/or (further) inventors are indicated on another continuation sheet.

PCT/US05/026742

Supplemental Box *If the Supplemental Box is not used, this sheet should not be included in the request.*

1. *If, in any of the Boxes, except Boxes Nos. VIII(i) to (v) for which a special continuation box is provided, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No...." (indicate the number of the Box) and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient. In particular:*

   (i) if more than two persons are to be indicated as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;

   (ii) if, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;

   (iii) if, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;

   (iv) if, in addition to the agent(s) indicated in Box No. IV, there are further agents: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;

   (v) if, in Box No. VI, there are more than three earlier applications whose priority is claimed: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI.

2. *If the applicant intends to make an indication of the wish that the international application be treated, in certain designated States, as an application for a patent of addition, certificate of addition, inventor's certificate of addition or utility certificate of addition: in such a case, write the name or two-letter code of each designated State concerned and the indication "patent of addition," "certificate of addition," "inventor's certificate of addition" or "utility certificate of addition," the number of the parent application or parent patent or other parent grant and the date of grant of the parent patent or other patent grant or the date of filing of the parent application (Rules 4.11(a)(iii) and 49bis.1(a) or (b)).*

AT, AU, DE, ES, IN, NZ, PL and EP, patent of addition, extension of EP patent, PCT/US2005?026739

3. *If the applicant intends to make an indication of the wish that the international application be treated, in the United States of America, as a continuation or continuation-in-part of an earlier application: in such a case, write "United States of America" or "US" and the indication "continuation" or "continuation-in-part" and the number and the filing date of the parent application (Rules 4.11(a)(iv) and 49bis.1(d)).*

US, continuation-in-part, PCT/US2005/026739

Box No. V DESIGNATIONS

The filing of this request constitutes under Rule 4.9(a), the designation of all Contracting States bound by the PCT on the international filing date, for the grant of every kind of protection available and, where applicable, for the grant of both regional and national patents.

However,

- ☐ DE Germany is not designated for any kind of national protection
- ☐ KR Republic of Korea is not designated for any kind of national protection
- ☐ RU Russian Federation is not designated for any kind of national protection

(The check-boxes above may be used to exclude (irrevocably) the designations concerned in order to avoid the ceasing of the effect, under the national law, of an earlier national application from which priority is claimed. See the Notes to Box No. V as to the consequences of such national law provisions in these and certain other States.)

Box No. VI PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country or Member of WTO	regional application:* regional Office	international application: receiving Office
item (1) 31/08/04	60/605,971	US		
item (2) 28/07/05	PCT/US2005/026739			US
item (3)				

☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office)* identified above as:

☒ all items ☐ item (1) ☐ item (2) ☐ item (3) ☐ other, see Supplemental Box

** Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii)):*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)*:

ISA / US

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority)*:

Date (day/month/year)	Number	Country (or regional Office)
28/07/05	PCT/US2005/026739	US

Box No. VIII DECLARATIONS

The following declarations are contained in Boxes Nos. VIII (i) to (v) *(mark the applicable check-boxes below and indicate in the right column the number of each type of declaration)*:		Number of declarations
☐ Box No. VIII (i)	Declaration as to the identity of the inventor	:
☒ Box No. VIII (ii)	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	:
☒ Box No. VIII (iii)	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	:
☒ Box No. VIII (iv)	Declaration of inventorship (only for the purposes of the designation of the United States of America)	:
☐ Box No. VIII (v)	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	:

See Notes to the request form

PCT/US06/00742

Box No. VIII (ii) DECLARATION: ENTITLEMENT TO APPLY FOR AND BE GRANTED A PATENT

The declaration must conform to the standardized wording provided for in Section 212; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (ii). If this Box is not used, this sheet should not be included in the request.

Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent (Rules 4.17(ii) and 51*bis*.1(a)(ii)), in a case where the declaration under Rule 4.17(iv) is not appropriate:

In relation to this internatinal application, GYROTRON TECHNOLOGY, INC., is entitled to apply for and be granted a patent by virtue of the following:
an assignment from:
SKLYARSVICH, VLADISLAV, 2701 Dudley Court, Bensalem, PA, USA and SHEVELEV, MYKHAYLO, 301 Heights Lane, Feasterville, PA, USA to GYROTRON TECHNOLOGY, INC. dated 26 July 2005 (26.07.2005).
This declaration is made for the purposes of all designations, except for the designation of the United States of America.

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (ii)".

PCT/US05/026739

Box No. VIII (ii) DECLARATION: ENTITLEMENT TO CLAIM PRIORITY

The declaration must conform to the standardized wording provided for in Section 213; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (ii). If this Box is not used, this sheet should not be included in the request.

Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application specified below, where the applicant is not the applicant who filed the earlier application or where the applicant's name has changed since the filing of the earlier application (Rules 4.17(ii) and 51*bis*.1(a)(iii)):

In relation to this international application, GYROTRON TECHNOLOGY, INC., is entitled to claim priority of earlier provisional application no. 60/605,971 and International Application No. PCT/US2005/026739 by virtue of an assignment of this international application from: SKLYAREVICH, VLADISLAV, 2701 Dudley Court, Bensalem, PA, USA and SHEVELEV, MYKHAYLO, 301 Heights Lane, Feasterville, PA, USA to GYROTRON TECHNOLOGY, INC. dated 26 July 2005 (26.07.2005).
This declaration is made for the purposes of all designations, except for the designation of the United States of America.

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (ii)".

PCT/US2005/026739

Box No. VIII (iv) DECLARATION: INVENTORSHIP (only for the purposes of the designation of the United States of America)

The declaration must conform to the following standardized wording provided for in Section 214; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (iv). If this Box is not used, this sheet should not be included in the request.

Declaration of inventorship (Rules 4.17(iv) and 51*bis*.1(a)(iv)) for the purposes of the designation of the United States of America:

I hereby declare that I believe I am the original, first and sole (if only one inventor is listed below) or joint (if more than one inventor is listed below) inventor of the subject matter which is claimed and for which a patent is sought.

This declaration is directed to the international application of which it forms a part (if filing declaration with application).

This declaration is directed to international application No. PCT/..... (if furnishing declaration pursuant to Rule 26*ter*).

I hereby declare that my residence, mailing address, and citizenship are as stated next to my name.

I hereby state that I have reviewed and understand the contents of the above-identified international application, including the claims of said application. I have identified in the request of said application, in compliance with PCT Rule 4.10, any claim to foreign priority, and I have identified below, under the heading "Prior Applications," by application number, country or Member of the World Trade Organization, day, month and year of filing, any application for a patent or inventor's certificate filed in a country other than the United States of America, including any PCT international application designating at least one country other than the United States of America, having a filing date before that of the application on which foreign priority is claimed.

Prior Applications: 60/605,971 ..... US, Filed 31 August 2004 .....

PCT/US2005/026739, Filed 28 July 2005 .....

I hereby acknowledge the duty to disclose information that is known by me to be material to patentability as defined by 37 C.F.R. § 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the PCT international filing date of the continuation-in-part application.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name: SKLYAREVICH, Vladislav .....

Residence: Bensalem, PA .....
(city and either US state, if applicable, or country)

Mailing Address: 2701 Dudley Court, Bensalem, PA 19020 US .....

.....

Citizenship: US .....

Inventor's Signature: Vladislav Sklyarevich Date: 12/22/05
(if not contained in the request, or if declaration is corrected or added under Rule 26*ter* after the filing of the international application. The signature must be that of the inventor, not that of the agent) (of signature which is not contained in the request, or of the declaration that is corrected or added under Rule 26*ter* after the filing of the international application)

Name: SHEVELEV, Mykhaylo .....

Residence: Feasterville, PA .....
(city and either US state, if applicable, or country)

Mailing Address: 301, Heights Lane, Feasterville, PA 19053 US .....

.....

Citizenship: UA .....

Inventor's Signature: Date: 12-22-05
(if not contained in the request, or if declaration is corrected or added under Rule 26*ter* after the filing of the international application. The signature must be that of the inventor, not that of the agent) (of signature which is not contained in the request, or of the declaration that is corrected or added under Rule 26*ter* after the filing of the international application)

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (iv)".

Box No. IX CHECK LIST; LANGUAGE OF FILING

This international application contains:		Number of sheets
(a) on paper, the following number of sheets:		
request (including declaration sheets)	: 8	
description (excluding sequence listing and/or tables related thereto)	: 10	
claims	: 4	
abstract	: 1	
drawings	: 2	
Sub-total number of sheets	: 25	0
sequence listing	:	
tables related thereto	:	
(for both, actual number of sheets if filed on paper, whether or not also filed in electronic form; see (c) below)		
Total number of sheets	: 25	0
(b) ☐ only in electronic form (Section 801(a)(i))		
(i) ☐ sequence listing		
(ii) ☐ tables related thereto		
(c) ☐ also in electronic form (Section 801(a)(ii))		
(i) ☐ sequence listing		
(ii) ☐ tables related thereto		
Type and number of carriers (diskette, CD-ROM, CD-R or other) on which are contained the		
☐ sequence listing:		
☐ tables related thereto:		
(additional copies to be indicated under items 9(ii) and/or 10(ii), in right column)		

This international application is accompanied by the following item(s) *(mark the applicable check-boxes below and indicate in right column the number of each item)*:	Number of items
1. ☒ fee calculation sheet	:
2. ☐ original separate power of attorney	:
3. ☐ original general power of attorney	:
4. ☐ copy of general power of attorney; reference number, if any:	:
5. ☐ statement explaining lack of signature	:
6. ☐ priority document(s) identified in Box No. VI as item(s):	:
7. ☐ translation of international application into *(language)*:	:
8. ☐ separate indications concerning deposited microorganism or other biological material	:
9. ☐ sequence listing in electronic form *(indicate type and number of carriers)*	
(i) ☐ copy submitted for the purposes of international search under Rule 13*ter* only (and not as part of the international application)	:
(ii) ☐ *(only where check-box (b)(i) or (c)(i) is marked in left column)* additional copies including, where applicable, the copy for the purposes of international search under Rule 13*ter*	:
(iii) ☐ together with relevant statement as to the identity of the copy or copies with the sequence listing mentioned in left column	:
10. ☐ tables in electronic form related to sequence listing *(indicate type and number of carriers)*	
(i) ☐ copy submitted for the purposes of international search under Section 802(b-*quater*) only (and not as part of the international application)	:
(ii) ☐ *(only where check-box (b)(ii) or (c)(ii) is marked in left column)* additional copies including, where applicable, the copy for the purposes of international search under Section 802(b-*quater*)	:
(iii) ☐ together with relevant statement as to the identity of the copy or copies with the tables mentioned in left column	:
11. ☒ other *(specify)*: Transmittal Letter	:

Figure of the drawings which should accompany the abstract:	Language of filing of the international application:
1	English

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Gyrotron Technology, Inc. (Applicant)

By: Vladislav Skylarvich

Vladislav Skylarvich, President

(05.01.06)

For receiving Office use only

1. Date of actual receipt of the purported international application: IAP7 Rec'd PCT/PTO 05 JAN 2006	2. Drawings: ☐ received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	☐ not received:
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA / US	6. ☐ Transmittal of search copy delayed until search fee is paid

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

PCT/US 06/00742 This sheet is part of and does not count as a sheet of the international application.

PCT

FEE CALCULATION SHEET
Annex to the Request

For receiving Office use only

International Application No. PCT/US 06/00742

05 JAN 2006 (05.01.06)
Date stamp of the receiving Office

Applicant's or agent's file reference: 4410 PCT CIP

Applicant:

CALCULATION OF PRESCRIBED FEES		
1. TRANSMITTAL FEE	300.00 [T]	300.00
2. SEARCH FEE	300.00 [S]	300.00
International search to be carried out by: US		
(If two or more International Searching Authorities are competent to carry out the international search, indicate the name of the Authority which is chosen to carry out the international search.)		
3. INTERNATIONAL FILING FEE		
Where items (b) and/or (c) of Box No. IX apply, enter Sub-total number of sheets / Where items (b) and (c) of Box No. IX do not apply, enter Total number of sheets: 25		
[i1] first 30 sheets	1,211.00 [i1]	1211.00
[i2] 0 (number of sheets in excess of 30) x 13 (fee per sheet) =	0 [i2]	
[i3] additional component (only if a sequence listing and/or tables related thereto are filed in electronic form under Section 801(a)(i), or both in that form and on paper, under Section 801(a)(ii)): 400 x 0 (fee per sheet) =	0 [i3]	
Add amounts entered at i1, i2 and i3 and enter total at I	USD 1,211.00 [I]	1211.00
(Applicants from certain States are entitled to a reduction of 75% of the international filing fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the international filing fee.)		
4. FEE FOR PRIORITY DOCUMENT *(if applicable)*	USD 40.00 [P]	40.00
5. TOTAL FEES PAYABLE Add amounts entered at T, S, I and P, and enter total in the TOTAL box	USD 1,551.00 TOTAL	1551.00

MODE OF PAYMENT *(Not all modes of payment may be available at all receiving Offices)*

- ☐ authorization to charge deposit account (see below)
- ☐ postal money order
- ☐ cash
- ☐ coupons
- ☒ cheque
- ☐ bank draft
- ☐ revenue stamps
- ☐ other *(specify)*:

AUTHORIZATION TO CHARGE (OR CREDIT) DEPOSIT ACCOUNT
(This mode of payment may not be available at all receiving Offices)

- ☐ Authorization to charge the total fees indicated above.
- ☐ *(This check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit)* Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.
- ☐ Authorization to charge the fee for priority document.

Receiving Office: RO/ _____
Deposit Account No.: _____
Date: _____
Name: _____
Signature: _____

See Notes to the fee calculation sheet

A METHOD OF SEPARATING NON-METALLIC MATERIAL USING MICROWAVE RADIATION

CROSS REFERENCE

This application, as permitted, is a continuation-in-part, a patent of addition or a certificate of addition, of International Application No. PCT/US 2005/026739, filed 18 July 2005.

TECHNICAL FIELD OF THE INVENTION

This invention generally relates to the physical separation of non-metallic materials into a plurality of smaller pieces. In particular, the invention relates to a method for splitting of a glass body, including laminated glasses.

BACKGROUND OF THE INVENTION

For manufacturing most products made of glass, laminated glass, semiconductor and other brittle non-metallic material, the separating of work stock into a number of smaller pieces of the desired size or sizes is required. For example, many glass products are formed by a large sheet of glass separated into smaller pieces of the desired size.

There are two main ways to cut glass and similar materials. The first is cutting glass and other brittle substrates that includes abrasion or scribing by the use of mechanical cutting tools. For example, glass sheets have been cut by scribing the glass with a diamond-tipped scribe or a carbide wheel to weaken the molecular structure. After the scribe has been made, physical pressure is applied to create a force at the scribe line to hopefully break the glass along the scribe line.

Another way of splitting bodies of glass and like material into parts is to use the thermal shock process produced by intense local heating of the body. The use of different heat sources for said local heating is known from the art. The most common among them are laser (see, for example US Patent Nos. 6,420,678; 3,629,545; 4,468,534; 5,609,284), hot gas (5,394,505) or fuel (5,394,505) jets.

Both ways have significant disadvantages. One significant disadvantage is the inability to obtain smooth edges. This may be unacceptable for many products, for example displays or solar panels, because of the required quality of the edge faces. Accordingly, secondary steps such as grinding, edge seaming, and polishing may be performed. However, such secondary steps slow down the manufacturing process, can be expensive and still, very often do not meet the requirements of the edge quality.

Another disadvantage is that edge defects on some of these rough edges may result in crack propagation during further processing or in the ultimate product. The edge strength of the substrate is also reduced. Glass can contaminate the substrate being separated, and require that additional clean-up steps be performed to minimize their impact on the manufacturing process.

The main reason for all these problems is that all known cutting methods from the art create weakness on the surface and then the glass breaks. In the case of using heat, this occurs because all the above-mentioned heat sources heat materials from the surface and do not penetrate inside. As a result, the compressive stress is produced only in the ultra thin heated layer of the surface. This also limits cutting speed. The use of mechanical tools in addition, involves the expenditure of much time and skill, because they are basically manual. Besides, mechanical tools are subject to wear, and worn tools result in inconsistent and unreliable cuts.

Cutting laminated glass is especially difficult and has many problems because of the interlayer that resists separation of the body. The most common way to cut laminated glass is to score both sides of the laminate, and bend it first to one side and then to the other side, the two parts of the laminated glass being pulled apart while performing the second bending step. The interlayer then is melted off simultaneously over the entire length of the parting line by a jet of heated air, flame, plasma etc. directed into the gap formed by the bending operation (see, for example, US Patents 5,944,244; 5,931,071; 5,704,959; 4,739,555; 4,558,622; 4,471,895 and 4,434,974). All known methods have the same problems as is described above for non laminated

glass plus laminated glass requires more time and effort. It is impossible to cut laminated glass that contains more than two glass sheets by this approach.

Using a high pressure water jet (see US Patent 4,728,379) allows cutting thicker laminates, but it is very slow and messy and still results in poor quality edge faces.

Consequently, achieving very smooth cuts on brittle material, especially glass, is a significant challenge in industry. Therefore, there exists the need for a method of dividing or parting substrates of brittle non-metallic material that overcomes these and other problems. The main advantages of a high speed and high quality cutting method are increasing production rate and reducing manufacturing costs.

SUMMARY OF THE INVENTION

This invention generally relates to the physical separation of bodies of a brittle non-metallic material, preferably glass sheets and pipes, by a thermal shock process in which a microwave radiation is used for rapid and selective heating of a local area of the body. Materials which may be separated by the inventive method include ceramics, semi-conductor wafer materials, glass, fiberglass, quartz, and the like. Material treated by this method can be used in the production of automotive and aircraft glazings, of construction and architectural window glass and the like, of pharmaceutical glass products and the like, of semiconductor wafers and the like, and glass components of various household items and furniture, and the like, structural optical components, and the like, mobile device displays, solar panels, and also in other fields of production and technologies where precision cutting of non-metallic materials is conducted or desirable.

According to the present invention, a method is provided for the separation of bodies of a brittle non-metallic material, preferably glass sheets, by a thermal shock. The inventive method utilizes concentrated microwave radiation to rapidly and

selectively heat the local area of the body to be thermally separated (e.g., a glass sheet, a glass pipe).

In the inventive method a concentrated microwave radiation with appropriate frequency and power density is chosen so as to accomplish heating of at least one selected area of the body at the required separating propagation path to the required temperature in a selected short time while insuring that this temperature is large enough to create a thermal stress through the thickness of the selected area which thereby results in the separating of the body material.

The inventive method avoids the use of existing mechanical and thermal tools that are slow and dusty and do not provide a high quality of cut. The present invention includes making the process easily adaptable for many applications, achieving fast cutting speeds and total separation of the substrate, obtaining smooth edges, and eliminating the need for secondary operations. Any kind of brittle material including those having low thermal expansion can be separated by the inventive method.

The main advantages of this high-speed method are the ability to cut a wide range of thicknesses (from super thick, more than 20mm to ultra thin, less than 1mm), high quality (dustless, chip and stress-free) and accuracy, reducing manufacturing costs and increasing production rate. Many other specific advantages also exist including but not limited to cutting complex shapes, the elimination of the cost and issues of grinding, transporting and transferring cut parts for grinding, cleaning cuts.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 schematically illustrates the temperature profile and compressive stresses that are produced inside a glass sheet when it is irradiated by concentrated microwave radiation.

FIG. 2 schematically illustrates a method for cutting, with simultaneous cooling in accordance with one embodiment of the invention .

FIG. 3 illustrates the compressive stresses that are produced inside a glass sheet when it is irradiated by an elongated microwave beam.

FIG. 4 illustrates a method in accordance with the teachings of the method of the present invention for cutting laminated glass with an elongated microwave beam that has different power density at its front and back.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a method of thermally separating a brittle non-metallic material, preferably a glass sheet, by a thermal shock. In the inventive method a microwave radiation with appropriate frequency and power density is used.

In all of the embodiments of the invention, the frequency (wavelength) of the concentrated microwave and power density of the applied microwave radiation are important parameters of the inventive method which must be determined for each type of body material and thickness of bodies processed. The process parameters are chosen so as to accomplish heating of selected area of a body at the required separating propagation path to required temperature in a selected time such that the difference in this temperature and the temperature of the rest of the body material is large enough to create a thermal stress that results in the separating of the body material in the heated area. In the inventive method said stress is created not only on the surface but through the thickness as well. Flat, non-flat, and pipe types of bodies can be separated using the inventive method.

These parameters and how they are chosen are generally described below for the embodiment of the invention in which a flat glass sheet is exposed to microwave radiation. However, it is understood that the same parameters and their choices are applicable to and must be considered in the alternative embodiments of the invention: cutting glass pipes, semiconductor materials, and like.

The inventive method is generally applicable to the thermal separation of any type of brittle non-metallic material. These treatments include but are not limited to the glass sheet employed in the production of windshields, side windows, and rear windows for vehicles such as automobiles and the like, the production of architectural window glass and related materials, the production of pharmaceutical glass products such as vials, ampoules, pipettes, and the like, display glass for mobile devices, solar panels, and the like, glass components of various household items and furniture, and the like, fiberglass and the like, as well as, semiconductor materials employed in the production of semiconductor wafers and the like.

The cutting of glass, under the action of thermal stresses, consists of the following. When concentrated microwave radiation (microwave beam) **1** (see Figure 1) is applied to a selected area **2** at the required separating propagation path **3** of the glass sheet **4**, the concentrated microwave radiation **1** passes through the glass sheet and heats the area throughout the depth. Curve **5** illustrates the temperature profile inside the glass sheet **4** that is created by this heating. Compressive stresses **6** are produced in the material being heated because the surrounding areas remain under lower temperature, as well as, surface temperature reduction just after heating under cooling by cold ambient air. The splitting of the plate glass occurs when these thermally-induced stresses exceed glass tensile strength.

While the tensile strength is determined primarily by the characteristics of the glass being processed, the compressive stresses can be increased because they mainly depend on the volume of the glass that is heated up, and the temperature gradients in and around the heated area. The rate of thermal splitting (cutting speed) in turn is dependent on how rapidly appropriate compressive stresses are created. All this means that the selected area should be heated throughout the thickness and it should be heated rapidly and to a high enough temperature. These conditions can be satisfied by the selection of effective microwave frequency and sufficient power density.

The particular frequency chosen should ensure the heating of the selected glass sheet area throughout the thickness of the glass sheet with maximum coupling of the incident microwave energy in the area. In addition, the chosen frequency should be cost effective and microwave generators for the selected frequency should be readily available at the required power.

We found that the frequency range of microwave energy that meets these requirements for most actual thicknesses and material properties where the inventive method can be applied is in the gigahertz range. However, the necessary power density drastically rises if the microwave frequency is lower than 10 GHz, and creates

many technical and economic problems. Therefore a higher microwave frequency is more preferable. On the other side, the current state-of-the-art level of microwave technique makes it very difficult and expensive to install a power system with a frequency higher than 1000 GHz. Thus, the effective microwave frequency range for the present invention is between about 10 GHz and about 1000 GHz. The preferable frequency is such that the skin layer for this frequency in the body material approximately equals its thickness. In this case, heating across the thickness is guarantied.

In the embodiments of the invention discussed above, a microwave absorbent, having a greater microwave absorption than the body material at a selected microwave irradiation frequency, is applied along the required separating propagation path. This allows increasing the cutting speed and accuracy because higher absorption increases the heating rate.

Heating rate increases more if microwave irradiation frequency is selected such that the skin layer for this frequency in the absorbent approximately equals its thickness. The absorbent is selected from the group consisting of semi-metals, carbides, nitrides, oxides, sulfides, silicides, boron, carbon, graphite and metals.

Cutting speed increases also if selected heated area and its surrounds of the body of material are cooled during exposure to microwave, as well as, before and after exposure, because this increases compressive stresses. A stream of cold gas 7 (see Figure 2), for example, liquid nitrogen steam that blows on the body, can be used for said cooling because gases are transparent to microwave. The body can be cooled by placing it on a cooled metal support and/or by placing a cold correspondently shaped plate on the surface that is exposed to microwave. The material of said plate is transparent to microwave and is selected from the group consisting of oxide ceramics, nitride ceramics, quartz and diamond.

Accuracy and cutting speed can be increased if the exposure to concentrated microwave radiation is conducted through a metal mask with an opening along the required propagation path.

It has been further found that maximal speed can be achieved by irradiating applied absorbent and/or irradiating through the mask, all at once.

Making a short scribing just at the edge on the glass surface makes the glass parting start more easily and more accurately, without losing the quality of cutting.

In the embodiments of the invention discussed above, an applied concentrated microwave radiation (microwave beam) 1 (see Figure 3) is elongated in the direction of the required separating propagation path 3. This allows increasing the cutting speed and accuracy because it creates higher compressive stresses, 6. The compressive stress increases also by moving the microwave beam during cutting along the separating propagation path from the beginning to the end and back at least two times. The beam power density and moving speed are selected sufficient to separate of the body material in the selected number of moves.

In the embodiments of the invention discussed above a microwave beam during the cutting of laminated glass moves at least two times along the separating propagation path from the beginning to the end and back. The beam power density during at least the first time, is selected sufficient to selectively eat polymer adhesive film to its delaminating temperature (around 80C-110C) along the separating propagation path before being followed by the step of separating of the glass body.

In the embodiments of the invention discussed above, cutting laminated glass is provided by an elongated microwave beam, in the direction of the required separating propagation path 3 (see Figure 4), with different power density in the beam

at the front 8a and the back 8b. The beam length, power density at its front, and speed are selected to be sufficient to heat polymer adhesive film 9 to its delaminating temperature (around 80C-110C) before being followed by the step of separating of the glass body.

Concentrated microwave radiation with the necessary frequency and power density can be achieved using generators such as the gyrotron, klystron, traveling wave tube, and backward wave oscillator, and the like.

The main distinctions of the inventive method are high cutting speed, quality of cut, and range of thicknesses that can be cut, as well as, eliminating the need for secondary operations. Any kind of brittle material including those having low thermal expansion can be separated by the inventive method.

The present invention has been described in an illustrative manner. It is to be understood that the terminology that has been used is intended to be in the nature of words of description rather than of limitation. Many modifications and variations of the present invention are possible in light of the above teachings. Therefore, within the scope of the appended claims, the present invention may be practiced other than as specifically described.

What is claimed is:

1. A method of separating a body of brittle non-metallic material by thermal shock comprising: exposing the body to concentrated microwave radiation of an effective frequency and sufficient power density to heat at least one selected area of the body at a required separating propagation path to a required temperature in a selected time whereby the selected power density, and exposure time are sufficient to ensure that the selected area is heated to said temperature which is higher than the rest of the body material temperature such that the difference in said temperatures is large enough to create a thermal stress through the thickness of the selected area that results in the separating of the body material.

2. The method in accordance with claim 1 wherein the microwave irradiation frequency is between about 10GHz to about 1000GHz.

3. The method in accordance with claim 1 wherein the preferable microwave irradiation frequency is selected such that the skin layer for this frequency in the body material is approximately equal to its thickness.

4. The method in accordance with claim 1 wherein the selected heated area and its surrounds of the body of material are cooled during, and optionally prior and after, exposure to microwave.

5. The method in accordance with claim 4 wherein cold gas is blown on and around the body.

6. The method in accordance with claim 4 wherein the body is placed on a cold metal.

7. The method in accordance with claim 4 wherein the microwave is exposed through a cold, and transparent to microwave, material that is lying upon the body's irradiated surface.

8. The method in accordance with claim 7 wherein the transparent material is selected from the group consisting of oxide ceramics, nitride ceramics, quartz and diamond.

9. The method in accordance with claims 1 wherein the exposure to microwave radiation is carried out through a metal mask with an opening along the required propagation path.

10. The method in accordance with claim 9 wherein the required propagation path is exposed to microwave all at once.

11. The method in accordance with claim 1 wherein a surface of the body is scribed at an edge area of the propagation path.

12. The method in accordance with claim 1 wherein the source of microwave radiation is selected from the group consisting of gyrotron, klystron, magnetron, traveling wave tube, and backward wave oscillator.

13. The method in accordance with claim 1 wherein a microwave absorbent having a greater microwave absorption than the body material at a selected microwave irradiation frequency is applied along the required separating propagation path.

14. The method in accordance with claim 13 wherein the microwave absorbent is selected from the group consisting of semi-metals, carbides, nitrides, oxides, sulfides, silicides, boron, carbon, graphite and metals.

15. The method in accordance with claim 13 wherein the microwave irradiation frequency is selected such that the skin layer for this frequency in the absorbent is approximately equal to its thickness.

16. The method in accordance with claim 13 wherein the entire applied absorbent is exposed to microwave all at once.

17. The method in accordance with claim 13 wherein the selected heated area and its surrounds of the body of material are cooled during, and optionally prior and after, exposure to microwave.

18. The method in accordance with claim 13, wherein the exposure to microwave radiation is carried out through a metal mask with an opening along the required propagation path.

19. The method in accordance with claim 13 wherein a surface of the body is scribed at an edge area of the propagation path.

20. The method in accordance with claim 13 wherein the source of microwave radiation is selected from the group consisting of gyrotron, klystron, magnetron, traveling wave tube, and backward wave oscillator.

21. The method in accordance with claim 1 wherein the applied concentrated microwave radiation is elongated in the direction of the required separating propagation path.

22. The method in accordance with claim 21 wherein the concentrated microwave radiation has a different power density at its front and back.

23. The method in accordance with claim 22 wherein the concentrated microwave radiation length, power density at its front, and speed are selected to be sufficient to heat adhesive film in a laminated glass body to delaminating temperature before being followed by the step of separating of the laminated glass body.

24. The method in accordance with claim 1 wherein the concentrated microwave radiation is moved at least two times along the separating propagation path from beginning to end and back.

25. The method in accordance with claim 24 wherein the brittle non-metallic material being separated is laminated glass having an intermediate adhered film and the concentrated microwave radiation power density during at least the first move is selected to be sufficient to selectively heat the polymer adhesive film along the separating propagation path to delaminating temperature before being followed by the step of separating the laminated glass body.

ABSTRACT

A method of high speed cutting of non-metallic materials (14), preferably glass and laminated glass, is described. In the inventive method a concentrated microwave radiation (1) with appropriate frequency and power density is chosen so as to accomplish heating of at least one selected area (2) of the body at the required separating propagation path (3) to required temperature in a selected short time while ensuring that this temperature is large enough to create a thermal stress (6) through the thickness of the selected area that results in the separating of the body material. In one embodiment of the invention a method of high speed cutting laminated glass is described wherein concentrated microwave radiation is used for delaminating adhesive film before the step of separating the glass body.

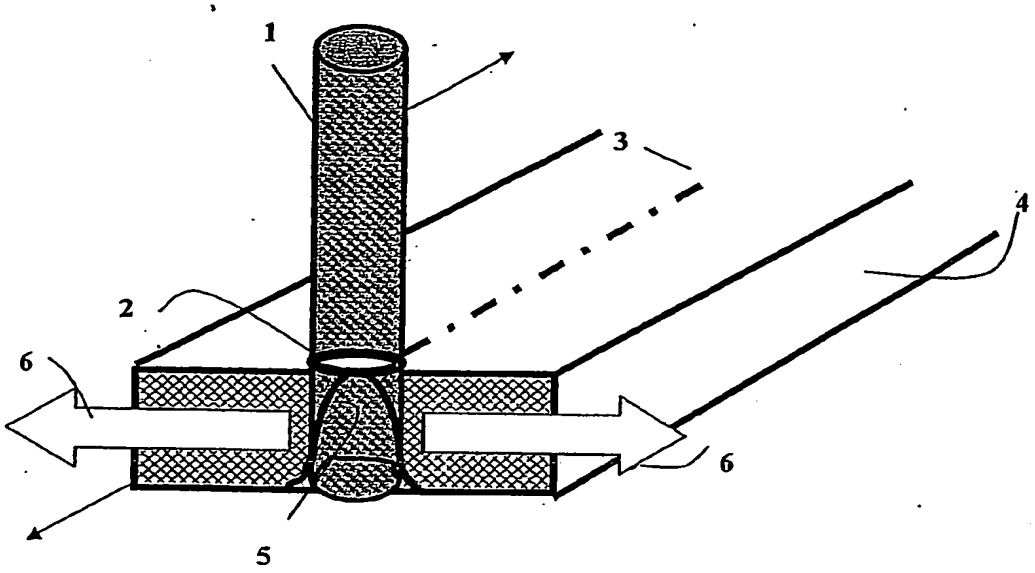

Figure 1

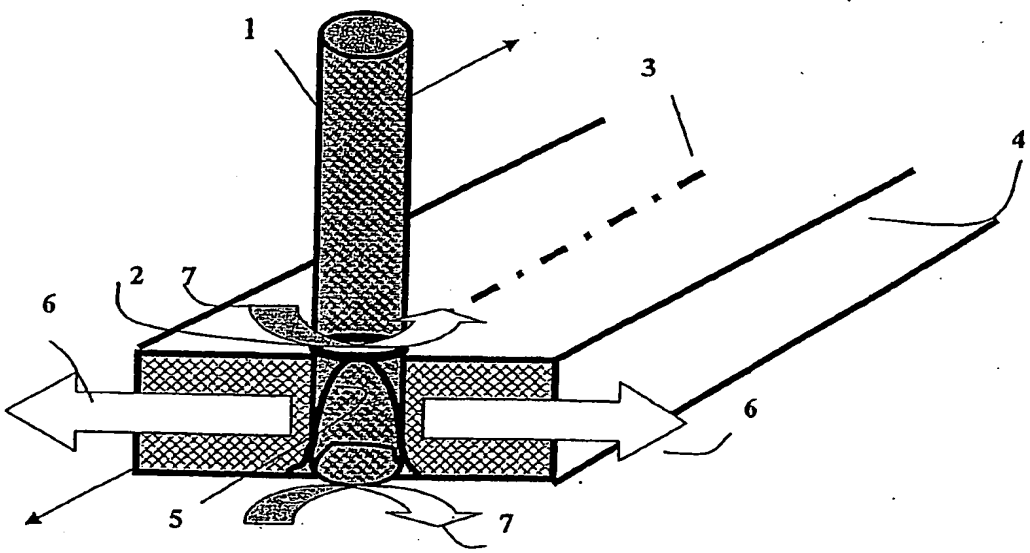

Figure 2

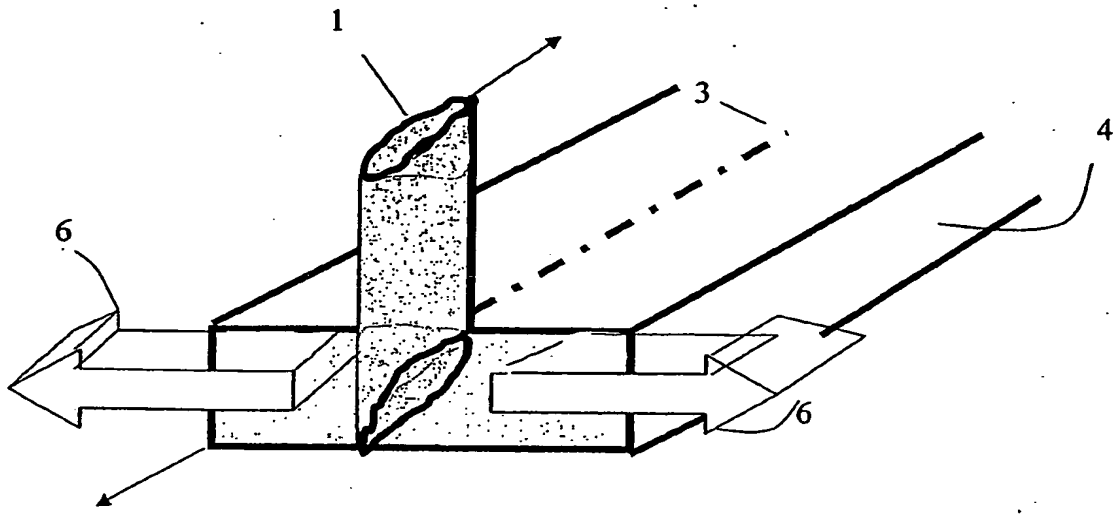

Figure 3

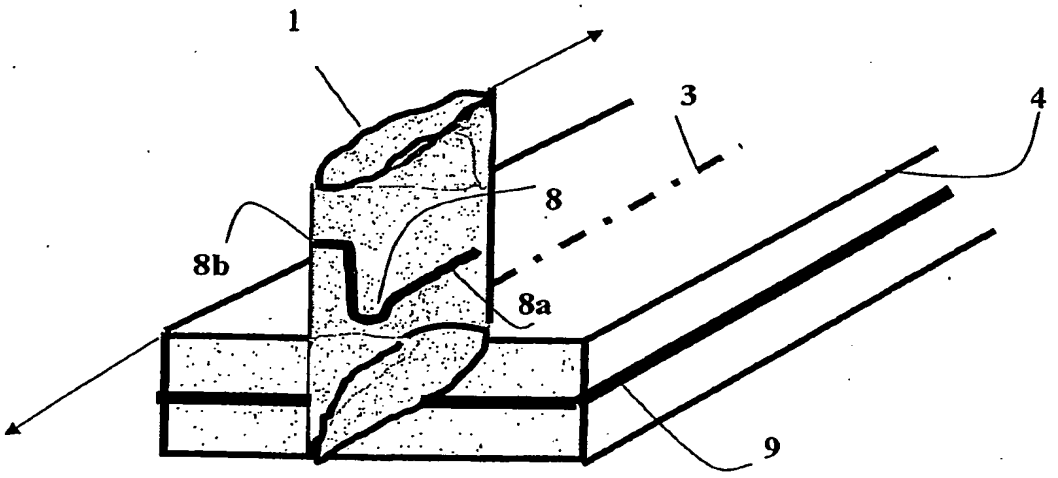

Figure 4

PCT/US06/00742

New International Application
Inventory of Unscannable or Missing
Items

Serial Number PCT/US 06/00742

Check This Column if Item is Present	Item	Check this column if Item is Missing on Filling
✓	Return Receipt Postcard	
	Credit Card	
✓	Check amount $ 1,551.00	
	Priority Document CD's	
	DNA Diskette/CD's	
	PCT EASY Diskette	
✓	Express Mail Label or Envelope	
✓	Transmittal Letter	
	Cover Letter	

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:

FLOY B. CAROTHERS
CAROTHERS AND CAROTHERS
SUITE 500
445 FORT PITT BLVD.
PITTSBURGH, PENNSYLVANIA 15219

PCT

NOTIFICATION CONCERNING PAYMENT OF PRESCRIBED FEES

(PCT Rules 14, 15 and 16 and Administrative Instructions, Sections 102*bis*(c), 304, 323(b), 707(b) and 803)

Date of mailing *(day/month/year)*	01 Mar 2006
Applicant's or agent's file reference: 4410 PCT CIP	PAYMENT DUE: see item 3 for time limits

International application No.	International filing date/Date of receipt *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2006/000742	05 Jan 2006	28 Jul 2005

Applicant: GYROTRON TECHNOLOGY, INC.

1. The applicant is hereby notified that this receiving Office has received:

☐ the payment of all the prescribed fees, and ☐ an overpayment, which will be refunded in due course.

☒ no or insufficient payment of the prescribed fees and the applicant is hereby invited to pay the balance due, as summarized under item 2, within the time limit(s) indicated under item 3.

2. Fees and payment calculation:

2,426.00	–	1,426.00	=	1,000.00
Total fees payable		Amount paid		Balance

☐ The details of the calculation are given in the Annex.

3. Time limit(s) for payment and amount(s) payable (Rules 14.1, 15.4 and 16.1(f)):

☐ within ONE MONTH from the date of receipt of the international application (for the transmittal fee (if any), the search fee and the international filing fee). The amount payable for each fee is the amount applicable on the date of receipt of the international application.

☐ within 16 MONTHS from the priority date (only for the fee for priority document). The applicant's attention is drawn to the fact that the request made by the applicant under Rule 17.1(b) will be considered not to have been made unless the fee is paid within that time limit.

4. Additional observations *(if necessary)*:

☐ The search copy will not be transmitted to the International Searching Authority until the search fee is paid (therefore the start of the international search will be delayed) (Rule 23.1(a) and (b)).

Name and mailing address of the receiving Office	Authorized officer
Mail Stop PCT, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 703-305-3230	Eric Simms Telephone No. 703-308-9290 EX 120

Form PCT/RO/102 (January 2004)

ANNEX TO FORM PCT/RO/102
CALCULATION OF THE PRESCRIBED FEES

International application No.
PCT/US2006/000742

[T] Transmittal Fee

Prescribed amount:		300.00 [T]	
Amount paid:	−	300.00	☒ correct amount
Balance:	=	0.00	☐ overpayment
			☐ balance due

[S] Search Fee

Prescribed amount:		1,000.00 [S]	
Amount paid:	−	0.00	☐ correct amount
Balance:	=	1,000.00	☐ overpayment
			☒ balance due

[I] International Filing Fee

Fixed amount for first 30 sheets: 1,086.00 [i1]

0 (Number of sheets in excess of 30) x 12.00 (Fee per sheet) = 0.00 [i2]

Additional component: . . . 400 x 0.00 (Fee per sheet) = 0.00 [i3]

Reduction where the international application is filed *(See PCT Applicant's Guide, Volume I, General Part, for details on the availability of this reduction)*:

using the PCT-EASY software:	−	0.00 [r]
or		
in electronic form where the text of the description, claims and abstract is not in character coded format:	−	0.00 [r]
or		
in electronic form where the text of the description, claims and abstract is in character coded format:	−	0.00 [r]
Sub-total:	=	1,086.00 [i1+i2+i3-r]

Prescribed total amount *(The amount to be entered at I is the sub-total entered at (i1+i2+i3-r), except where the applicant is (or all applicants are) entitled to a reduction of 75%, in which case the amount to be entered at I is 25% of the sub-total (i1+i2+i3-r); certain applicants from certain States are entitled to a reduction of 75% of the international filing fee; see Notes to the Fee Calculation Sheet as annexed to the Request Form, PCT/RO/101, for details)*:

	=	1,086.00 [I]	
Amount paid:	−	1,086.00	☒ correct amount
Balance:	=	0.00	☐ overpayment
			☐ balance due

[P] Fee for Priority Document

Prescribed amount:		40.00 [P]	
Amount paid:	−	40.00	☒ correct amount
Balance:	=	0.00	☐ overpayment
			☐ balance due

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NOTIFICATION OF THE INTERNATIONAL APPLICATION NUMBER AND OF THE INTERNATIONAL FILING DATE

(PCT Rule 20.5(c))

Date of mailing *(day/month/year)*	01 Mar 2006
Applicant's or agent's file reference: 4410 PCT CIP	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2006/000742	05 Jan 2006	28 Jul 2005

Applicant: GYROTRON TECHNOLOGY, INC.

Title of the invention: A METHOD OF SEPARATING NON-METALLIC MATERIAL USING MICROWAVE RADIATION

1. The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above.

2. The applicant is further notified that the record copy of the international application:

☒ was transmitted to the International Bureau on 01 Mar 2006

☐ has not yet been transmitted to the International Bureau for the reason indicated below and a copy of this notification has been sent to the International Bureau*:

☐ because the necessary national security clearance has not yet been obtained.

☐ because *(reason to be specified)*:

* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22.1(c)).

3. FOREIGN TRANSMITTAL LICENSE INFORMATION Completed by: ES

☐ Additional license for foreign transmittal not required. This subject matter is covered by a license already granted or the equivalent U.S. national application. Refer to that license for information concerning its scope.

☐ License for foreign transmittal not required. 37 CFR 5.11(e)(1) or 37 CFR 5.11(e)(2). However, a license may be required for additional subject matter. See 37 CFR 5.15(b).

☒ Foreign transmittal license granted. 35 U.S.C. 184; 37 CFR 5.11 on 23 Feb 2006 (date):

☐ 37 CFR 5.15(a) ☒ 37 CFR 5.15(b)

Name and mailing address of the receiving Office Mail Stop PCT, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 703-305-3230	Authorized officer Eric Simms Telephone No. 703-308-9290 EX 120

Form PCT/RO/105 (July 1992)

PATENT COOPERATION TREATY

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PITTSBURGH, PENNSYLVANIA 15219

PCT

INVITATION TO CORRECT DEFECTS IN THE INTERNATIONAL APPLICATION

(PCT Articles 3(4)(i) and 14(1) and Rule 26)

Date of mailing *(day/month/year)*	01 Mar 2006
Applicant's or agent's file reference: 4410 PCT CIP	REPLY DUE within 1 months/days from the above date of mailing
International application No.: PCT/US2006/000742	International filing date *(day/month/year)*: 05 Jan 2006
Applicant: GYROTRON TECHNOLOGY, INC.	

1. ☒ The applicant is hereby invited, within the time limit indicated above, to correct, in the international application as filed, the defects specified on the attached:
   - Annex A
   - ☐ Annex B1 *(text matter of the international application as filed)*
   - ☒ Annex C1 *(drawings of the international application as filed)*

2. ☐ The applicant is hereby invited, within the time limit indicated above, to correct, in the translation of the international application furnished under Rule 12.3 or 12.4, the defects specified on the attached:
   - ☐ Annex A
   - ☐ Annex B2 *(text matter of the translation of the international application)*
   - ☐ Annex C2 *(drawings of the translation of the international application)*

Additional observations (if necessary):

HOW TO CORRECT THE DEFECTS?

Correction must be submitted by filing a replacement sheet embodying the correction and a letter accompanying the replacement sheet, which shall draw attention to the difference between the replaced sheet and the replacement sheet. A correction may be stated in a letter only if it is of such a nature that it can be transferred from the letter to the record copy without adversely affecting the clarity and direct reproducibility of the sheet onto which the correction is to be transferred (Rule 26.4).

ATTENTION

Failure to correct the defects will result in the international application being considered withdrawn by this receiving Office (see Rule 26.5 for further details).

A copy of this invitation and any attachments has been sent to the International Bureau
☒ and the International Searching Authority

Name and mailing address of the receiving Office Mail Stop PCT, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 703-305-3230	Authorized officer Eric Simms Telephone No. 703-308-9290 EX 120

Form PCT/RO/106 (January 2004)

ANNEX C1 TO FORM PCT/RO/106

International application No.
PCT/US2006/000742

This receiving Office has found that, with regard to the presentation of the drawings of the international application as filed, the physical requirements are not complied with to the extent that compliance therewith is necessary for:

1. [x] reasonably uniform international publication (Rules 11 and 26.3(a)(i)) *(defects to be specified)*:

Sheets containing drawings:

a. [ ] the sheets do not admit of direct reproduction
b. [ ] the sheets are not free from creases, cracks, folds
c. [ ] one side of the sheets is not left unused
d. [ ] the paper of the sheets is not flexible/strong/white/smooth/non-shiny/durable
e. [ ] the drawings do not commence on a new sheet
f. [ ] the sheets are not connected as prescribed (Rule 11.4(b))
g. [ ] the sheets are not A4 size (29.7cm x 21cm)
h. [ ] the minimum margins on the sheets are not as prescribed (top: 2.5cm; left side: 2.5cm; right side: 1.5cm; bottom: 1cm)
i. [ ] the file reference number indicated on the sheets does not appear in the left-hand corner of the sheets, within 1.5 cm of the top of the sheets
j. [ ] the file reference number exceeds the maximum of 12 characters
k. [ ] the sheets are not free from frames around usable or used surfaces
l. [x] the sheets are not numbered in consecutive Arabic numerals (e.g. 1/3, 2/3, 3/3)
m. [ ] the sheet numbers are not centered at the top or bottom of the sheets
n. [ ] the sheet numbers are in the margin (see h. above for the size of the margins)
o. [ ] the sheets contain alterations/overwritings/interlineations/too many erasures
p. [x] the sheets contain photocopy marks

Drawings (Rule 11.13):

a. [ ] do not admit of direct reproduction
b. [ ] contain unnecessary text matter
c. [ ] contain words so placed as to prevent translation without interference with lines thereof
d. [ ] are not executed in durable black color; the lines are not uniformly thick and well-defined
e. [ ] contain cross-sections not properly hatched
f. [ ] would not be properly distinguishable in reduced reproduction
g. [ ] contain scales not represented graphically
h. [ ] contain numbers, letters and reference lines lacking simplicity and clarity
i. [ ] contain lines drafted without the aid of drafting instruments
j. [ ] contain disproportionate elements of a figure not necessary for clarity
k. [ ] contain numbers and letters of height less than 0.32 cm
l. [ ] contain letters not conforming to the Latin, and where customary, Greek alphabets
m. [ ] contain figures on two or more sheets which form a single complete figure but which are not able to be assembled without concealing parts thereof
n. [ ] contain figures which are not properly arranged and clearly separated
o. [ ] contain different figures not numbered in consecutive Arabic numerals
p. [ ] contain different figures not numbered independently of the numbering of the sheets
q. [ ] are not restricted to reference signs mentioned in the description
r. [ ] do not contain reference signs that are mentioned in the description
s. [ ] contain the same feature denoted by different reference signs
t. [ ] are not arranged in an upright position, clearly separated from one another
u. [ ] are not presented sideways with the top of the figures at the left side of the sheets

2. [ ] satisfactory reproduction (Rules 11 and 26.3(b)(i))

Further observations (if necessary):

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:
FLOY B. CAROTHERS
CAROTHERS AND CAROTHERS
SUITE 500
445 FORT PITT BLVD.
PITTSBURGH, PENNSYLVANIA 15219

PCT

INVITATION TO CORRECT PRIORITY CLAIM

(PCT Rules 4.10, 26*bis*.1, 26*bis*.2(a) and (b))

Date of mailing *(day/month/year)*	01 Mar 2006
Applicant's or agent's file reference: 4410 PCT CIP	REPLY DUE: See item 1
International application No.: PCT/US2006/000742	International filing date *(day/month/year)*: 05 Jan 2006
Applicant: GYROTRON TECHNOLOGY, INC.	

The applicant is hereby invited, within the time limit indicated below, to correct, by a notice submitted to this receiving Office, defects in the priority claim(s), as indicated in the Annex.

1. **Time limit to respond to this Invitation (Rule 26*bis*.1(a)):**

   – within 16 months from the (earliest) priority date; or

   – if the (earliest) priority date is changed as a result of the correction or addition of the (earliest) priority claim, within 16 months from that (earliest) priority date so changed,

   whichever expires first, provided that such a notice may, in any event, be submitted until the expiration of four months from the international filing date.

   Failure to respond to this Invitation within the prescribed time limit may result in the priority claim concerned to be considered, for the purposes of the procedure under the PCT, not to have been made (Rule 26*bis*.2(b)).

2. **In the case where multiple priorities have been claimed, this invitation relates to the following priority claim(s):**

   Box VI I

3. A copy of this Invitation is being sent to the International Bureau.

Name and mailing address of the receiving Office Mail Stop PCT, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 703-305-3230	Authorized officer Eric Simms Telephone No. 703-308-9290 EX 120

Form PCT/RO/110 (July 1998; reprint January 2004)

ANNEX TO FORM PCT/RO/110

International application No.
PCT/US2006/000742

This receiving Office has found the following defects in the priority claim(s):

1. **Failure to Comply with the Requirements of Rule 4.10**

a. [X] **National application**

- [ ] Missing indication of the filing date of the earlier application.
- [X] Filing date indicated for the earlier application does not fall within the period of 12 months preceding the international filing date.
- [ ] Missing indication of the number of the earlier application.*
- [ ] Missing indication of the country party to the Paris Convention for the Protection of Industrial Property, or of the Member of the World Trade Organization that is not party to that Convention, in which the earlier national application was filed.
- [ ] The country indicated is neither a party to the Paris Convention for the Protection of Industrial Property nor a Member of the World Trade Organization.

b. [ ] **Regional application**

- [ ] Missing indication of the filing date of the earlier application.
- [ ] Filing date indicated for the earlier application does not fall within the period of 12 months preceding the international filing date.
- [ ] Missing indication of the number of the earlier application.*
- [ ] Missing indication of the authority entrusted with the granting of regional patents under the applicable regional patent treaty.
- [ ] The authority indicated as the authority entrusted with the granting of regional patents does not grant regional patents.
- [ ] The priority claim in relation to the ARIPO application does not indicate either at least one country party to the Paris Convention for the Protection of Industrial Property, or at least one Member of the World Trade Organization, for which the earlier application was filed.

c. [ ] **International application**

- [ ] Missing indication of the filing date of the earlier application.
- [ ] Filing date indicated for the earlier application does not fall within the period of 12 months preceding the international filing date.
- [ ] Missing indication of the number of the earlier application.*
- [ ] Missing indication of the receiving Office with which it was filed.

2. **Inconsistency with the Corresponding Indications in the Priority Document***

a. [ ] Inconsistency with regard to the filing date of the earlier application:

The request indicates:

The priority document indicates:

b. [ ] Inconsistency with regard to the number of the earlier application:

The request indicates:

The priority document indicates:

c. [ ] Inconsistency with regard to the country party to the Paris Convention for the Protection of Industrial Property or the Member of the World Trade Organization in which the national application was filed:

The request indicates:

The priority document indicates:

d. [ ] Inconsistency with regard to the authority entrusted with the granting of *regional patents* under the applicable regional patent treaty:

The request indicates:

The priority document indicates:

e. [ ] Inconsistency with regard to the receiving Office with which the international application was filed:

The request indicates:

The priority document indicates:

* Even if this defect is not corrected in response to this Invitation, the priority claim concerned will not be considered not to have been made (Rule 26*bis*.2(b)).

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:

FLOY B. CAROTHERS
CAROTHERS AND CAROTHERS
SUITE 500
445 FORT PITT BLVD.
PITTSBURGH, PENNSYLVANIA 15219

PCT

NOTIFICATION OF RECEIPT
OF SEARCH COPY

(PCT Rule 25.1)

Date of mailing *(day/month/year)*	01 Mar 2006
Applicant's or agent's file reference: 4410 PCT CIP	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2006/000742	05 Jan 2006	28 Jul 2005

Applicant

GYROTRON TECHNOLOGY, INC.

1. **Where the International Searching Authority and the receiving Office are not the same Office:**
The applicant is hereby notified that the search copy of the international application was received by this International Searching Authority on the date indicated below.

Where the International Searching Authority and the receiving Office are the same Office:
The applicant is hereby notified that the search copy of the international application was received on the date indicated below.

01 Mar 2006 *(date of receipt)*.

2. ☐ The search copy was accompanied by a nucleotide and/or amino acid sequence listing or tables related thereto in computer readable form.

3. **Time limit for establishment of international search report and written opinion of the International Searching Authority**
The applicant is informed that the time limit for establishing the international search report and the written opinion of the International Searching Authority is three months from the date of receipt indicated above or nine months from the priority date, whichever time limit expires later (Rules 42.1 and 43*bis*.1(a)).

4. A copy of this notification has been sent to the International Bureau and, where the first sentence of paragraph 1 applies, to the receiving Office.

Name and mailing address of the ISA/	Authorized officer
Mail Stop PCT, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450	Eric Simms
Facsimile No. 703-305-3230	Telephone No. 703-308-9290 EX 120

Form PCT/ISA/202 (January 2004)

IAP7 Rec'd PCT/PTO 05 JAN 2006

TRANSMITTAL LETTER TO THE UNITED STATES RECEIVING OFFICE

Date	January 5, 2006
International Application No.	PCT/US 06/00742
Attorney Docket No.	4410 PCT CIP

I. (Certification under 37 CFR 1.10 (if applicable))

EQ046732925US	January 5, 2006
Express Mail mailing number	Date of Deposit

I hereby certify that the application/correspondence attached hereto is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to Assistant Commissioner for Patents, Washington, D.C. 20231.

Jean K. Carothers	Jean K. Carothers
Signature of person mailing correspondence	Typed or printed name of person mailing correspondence

II. [X] New International Application

TITLE	A METHOD OF SEPARATING NON-METALLIC MATERIAL USING MICROWAVE RADIATION	Earliest priority date (Day/Month/Year): 31 Aug. 2004

SCREENING DISCLOSURE INFORMATION: In order to assist in screening the accompanying international application for purposes of determining whether a license for foreign transmitt al should and could be granted and for other puposes, the following information is supplied. (Note: check as many bo xes as apply):

A. [ ] The invention disclosed was not made in the United States.

B. [ ] There is no prior U.S. application relating to this invention.

C. [X] The following prior U.S. application(s) contain subject matter which is related to the invention disclosed in the attached international application. (*NOTE: priority to these applications may or may not be claimed on form PCT/RO/101 (Request) and this listing does not constitute a claim for priority.*)

application no.	60/605,971 US	filed on	31 August 2004
application no.	PCT/US2005/026739	filed on	28 July 2005

D. [X] The present international application [ ] contains additional subject matter not found in the prior U.S. application(s) i dentified in paragraph C. above. The additional subject matter is found on pages 1,2,5,9,10,13,14 & 15 and [X] DOES NOT ALTER [ ] MIGHT BE CONSIDERED TO ALTER the general nature of the invention in a manner which would require the U.S. application to have been made available for inspection by the appropriate defense agencies under 35 U.S.C. 181 and 37 CFR 5.1. See 37 CFR 5.15

III. [ ] A Response to an Invitation from the RO/US. The following document(s) is(are) enclosed:

A. [ ] A Request for An Extension of Time to File a Response

B. [ ] A Power of Attorney (General or Regular)

C. [ ] Replacement pages:

pages		of the request (PCT/RO/101)	pages		of the figures
pages		of the description	pages		of the abstract
pages		of the claims			

D. [ ] Submission of Priority Documents

Priority document		Priority document	

E. [ ] Fees as specified on attached Fee Calculation sheet form PCT/RO/101 annex

IV. [ ] A Request for Rectification under PCT 91 [ ] A Petition [ ] A Sequence Listing Diskette

V. [ ] Other (please specify):

The person signing this form is the:	[ ] Applicant	Floyd B. Carothers
	[X] Attorney/Agent (Reg. No.) 24,252	Typed name of signer
	[ ] Common Representative	Floyd B Carothers
		Signature

PTO-1382 (Rev. 12-1996) U.S. Department of Commerce: Patent and Trademark Office